PERFORMANCE REPORT

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INLAND FISHERIES DIVISION MONITORING AND MANAGEMENT PROGRAM

2011 Survey Report

Amistad Reservoir

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SURVEY AND MANAGEMENT SUMMARY

This report summarizes results of surveys conducted from July 2008 to June 2012 and contains a management plan for the reservoir. Fish populations were surveyed using electrofishing and gill nets. A six-month duration creel survey and two vegetation surveys were also conducted.

- **Reservoir Description:** Amistad Reservoir is a 63,680 acre impoundment on the Rio Grande River. It was constructed in 1969 and managed by the International Boundary and Water Commission to provide water for irrigation and hydro-electric power generation. During the study period, water level increased from 20 feet low, remained within 5 feet of full pool for about three years, then decreased to about 20 feet low. Abundance of submersed aquatic vegetation declined substantially during the study period. Boat and angler access is excellent; the National Park Service (NPS) maintains 11 public boat ramps.

- **Management History:** Important sport fishes include largemouth bass, catfishes, striped bass, and white bass. Striped bass were stocked in most years since 1974. Florida largemouth bass (FLMB) were stocked periodically from 1975 to 2006 and annually since 2008 to improve FLMB introgression and trophy largemouth bass potential. Angler harvest of all sport fishes has been regulated according to statewide size and bag limits. Since 2004, the NPS has regulated largemouth bass tournaments via a tournament permitting program.

- **Fish Community**
  - **Prey species:** Gizzard shad and sunfishes formed the reservoir's forage base. Most of the gizzard shad sampled were too large to be considered potential forage for largemouth bass. Abundance of gizzard shad and bluegill has declined in recent years, but forage remains sufficient to support the existing predator fish populations.

  - **Catfishes:** Channel, blue, and flathead catfish are present in the reservoir in low abundance. Angling effort directed at catfishes remains low and accounted for 1.1% of total angling effort in the reservoir according to 2012 creel survey studies.

  - **White bass:** Abundance of white bass during 2008-2012 exceeded historic average abundance. Angling effort directed at white bass remained low, accounting for 1.3% of total angling effort in 2012.

  - **Striped bass:** Abundance of striped bass during 2008-2012 was below historic average abundance. Angling effort directed at striped bass remained low, accounting for 0.2% of total angling effort in 2012.

  - **Largemouth bass:** Abundance of largemouth bass peaked in 2009 and then decreased to below the historic average in 2011. However, abundance of fish >14 during the 2008-2012 study period remained above historic average abundance. Nearly all (95.2%) of the angling effort at the reservoir was directed for largemouth bass during 2012, of which 32.9% was tournament angling. Five ShareLunker fish were contributed from the reservoir during 2008-2012.

- **Management Strategies:** Continue to provide a striped bass fishery supported by annual stockings. Continue stocking FLMB on an annual basis to maintain high Florida bass introgression and production of trophy fish.

INTRODUCTION

This document is a summary of Amistad Reservoir fisheries data collected from July 2008 to June 2012. Its purpose is to provide fisheries information and formulate management recommendations to protect and improve the sport fishery. While information on other species of fishes was collected, this report deals primarily with major sport fishes and important prey species. Historical data is presented for comparison.

Reservoir Description

Amistad Reservoir is a 63,680 acre impoundment on the Rio Grande River, of which 34,312 acres (54%) lie within Texas. It was constructed in 1969 by the International Boundary and Water Commission to provide water for irrigation and hydro-electric power generation. Most of the Texas shoreline is federally owned and managed by the National Park Service (NPS) as a National Recreation Area. The NPS maintains 11 public boat ramps at the reservoir, with most having courtesy docks. They also provide two fish cleaning stations and operate a tournament permitting and scheduling program to avoid over crowded situations at boat ramps and to obtain tournament catch statistics. On average, there are 153 tournament events and 31, 472 black bass weighed-in per year (Amistad Reservoir Black Bass Tournaments, 2008 Annual Report). The total economic value of the fishery was estimated to be $22.7 million in 2007 (Schuett et al. 2012). Other descriptive characteristics for the reservoir are contained in Table 1.

Management History

Previous management strategies and actions: Management strategies and actions from the previous survey report (Myers and Dennis 2007) included:

1. Stock striped bass annually at 3-5 fish/ acre.
   Action: Striped bass were stocked annually at 3-5 fish/acre from 2008 to 2010. Insufficient hatchery production prevented stocking in 2011.
2. Determine the potential effects of reducing the largemouth bass bag limit to 3-fish.
   Action: Annual creel data from 2007 were analyzed using a simulation model to predict the effect of a bag limit reduction on angler harvest (see methods). The analysis revealed that reducing the bag-limit to 3-fish would result in only a minor decrease in total fish deaths attributed to harvest (7.4%). We recommend that the daily black bass bag limit remain at 5 fish (see results and Appendix C).
3. Conduct special research project to quantify post-release survival of fish treated for barotrauma and compare effectiveness of the various treatment methods.
   Action: Special project was conducted in 2009-2010. Barotrauma lowered post-release survival of tournament bass by 14% and side-fizzing proved to be the most effective of the treatment methods.

Harvest regulation history: Since impoundment, harvest of all sport fishes has been managed according to statewide regulations (Table 2).

Stocking history: Both Florida (FLMB) and northern strain (NLMB) largemouth bass, blue and channel catfish, smallmouth bass, striped bass, palmetto bass, walleye, northern pike, and muskellunge have been stocked. Stockings of FLMB were annual in the 1970s and sporadic in the 1980s and 1990s. About 500,000 FLMB fingerlings were stocked in both 2004 and 2008, capitalizing on the improved habitat resulting from a substantial water level increase. Annual stockings of about 250,000 FLMB have been conducted since 2010 to maintain high FLMB introgression and trophy potential. Smallmouth bass stockings were conducted in the late 1970s and early 1980s, but were later discontinued. A high quality smallmouth bass fishery developed in the Devils River above the reservoir, and incidental catches of smallmouth bass occur in the Devils River arm of the reservoir.

Channel and blue catfish were last stocked in 1973 and 1967, respectively, and populations for these species are self-sustaining. Experimental stockings of northern pike, walleye, and muskellunge were conducted in the 1970s, but were unsuccessful and thus discontinued. The complete stocking history is contained in Table 3.

Vegetation/habitat history: Fisheries habitat quality and aquatic vegetation abundance has varied widely due to dramatic changes in water level. The reservoir experienced prolonged low water level (≥35 feet low) from 1994 to 2003 (Figure 1). During this time aquatic vegetation was sparse in the reservoir (Zerr 2000, Dean 2003) and terrestrial vegetation (primarily huisache) grew on the exposed reservoir bottom. Water level then increased by nearly 50 feet in 2003-2004 inundating the terrestrial vegetation providing optimal fisheries habitat. Aquatic vegetation abundance increased following this substantial rise in water level, with hydrilla occupying 7,995 acres, chara 4,049 acres, and pondweed spp. 5,353 acres (Myers and Dennis 2007).

Water Transfer: Amistad Reservoir as well as other reservoirs built on the Rio Grande River is used to store, conserve, and distribute water for downstream irrigation needs in both Mexico and the U.S. Rio Grande River water is allocated per terms of a treaty formed in 1944 between the two countries. Each country has separate operational control of the dam and release water in response to downstream irrigation needs.

METHODS

All standard fisheries surveys were conducted according to the latest version of TPWD Fishery Assessment Procedures, except that sampling occurred only on the Texas portion of the reservoir (Appendix A). Fishes were collected by electrofishing (2 hours at 24 5-minute stations) during fall. Standard electrofishing surveys were conducted during night time at random stations (Appendix A). Additional daytime electrofishing was conducted at 5-minute random and biologist selected stations with varying effort in 2006 and 2007. Gill netting was conducted during winter months (15 net-nights at 15 stations) at random sites. Catch per unit effort (CPUE) for electrofishing was recorded as the number of fish caught per hour (fish/h) of actual electrofishing, and for gill nets as the number of fish per net night (fish/nn). Figures displaying historic trend in CPUE since 1999 (initiation of random sampling protocol) are presented for harvest-regulated species.

Sampling statistics (CPUE for various length categories), structural indices [Proportional Size Distribution (PSD)] as defined by Guy et al. (2007), and condition [relative weight (W_r)] were calculated for target fishes according to Anderson and Neumann (1996). Index of vulnerability (IOV) was calculated for gizzard shad (DiCenzo et al. 1996). Relative standard error (RSE = 100 X SE of the estimate/estimate) was calculated for all CPUE statistics and SE was calculated for structural indices and IOV. Ages of largemouth bass and white bass were determined using otoliths.

Genetic analysis of largemouth bass was conducted according to the latest version of the TPWD Fishery Assessment Procedures. Since 2006, micro-satellite methods were used to perform genetic analysis. Electrophoresis was used prior to 2006.

A shoreline structural habitat survey was conducted in 2010 and vegetation surveys were conducted in 2008 and 2011. These surveys were conducted according to the TPWD Fishery Assessment Procedures in effect at time of the surveys.

Creel survey sampling was conducted from 1/1/2012 to 6/30/2012 (6 months). Sampling was conducted according to the latest version of TPWD Fishery Assessment Procedures. Additionally, estimated weights of caught and released largemouth bass >14 inches were obtained from interviewed anglers to estimate number of fish released by weight category (< 4lbs, 4-7 lbs. 7-10 lbs, and >10 lbs.).

Per previous management strategy 2 listed above, the benefit of reducing the largemouth daily bag limit from 5 to 3 fish was simulated using the following formula and 2007 annual creel data.

$SF = OHAR - NBL * PS$
$PR_{type1} = \sum SF_{type1} \div \sum OHAR_{type1}$
$TSF_{type1} = PR_{type1} * THAR_{type1}$

Where,
SF = number of fish harvested under the 5-fish bag limit that would have been released under a 3 fish bag limit (by angling party);
OHAR = number of fish observed harvested;
NBL = 3 (new bag limit);
PS = number of anglers in angling party;
PR = percent reduction in number of harvested fish;
Type1 = angler type (tournament or non-tournament);
TSF = predicted total fish harvest if bag limit would have been 3 fish; and
THAR = actual total fish harvest under 5-fish bag limit.

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RESULTS AND DISCUSSION

Habitat: During the study period water level fluctuated widely and aquatic vegetation abundance declined substantially. Water level increased about 20 feet in summer 2008 and remained within 5 feet of conservation elevation until early 2011 (Figure 1). At that time, water level began a steady decline and in May 2012 was again about 20 feet below conservation elevation. Percent occurrence for all vegetation species combined declined from 38.9% in 2007 (Myers and Dennis 2007), to 28.8% in 2008 and then to 18.5% in 2011 (Figure 2 and Table 4). Of the vegetation species/types, hydrilla experienced the greatest decline in percent occurrence, from 23.3% in 2007 to 19.8 in 2008 and then to 5.2% in 2011. Pondweed species, the second most abundant aquatic vegetation in the reservoir, experienced only a slight change in abundance. Percent occurrence for combined pondweed spp. was 15.6% in 2007, 10.7% in 2008, and 12.3% in 2011. The maximum depth at which hydrilla was found was 24-27 feet which was shallower than found in 2007 (32 feet; Myers and Dennis 2007). Pondweed spp., however, were found growing at a greater maximum depth during the study period (22-25 feet) than in 2007 (15 feet). The 20 foot water level increase in 2008 benefited fisheries habitat due to inundation of newly-established terrestrial vegetation. However this benefit was likely offset by the large reduction in aquatic vegetation abundance. The 2-3 year period of high and relatively stable water level after 2008 was responsible for the decline in aquatic vegetation abundance. In 2010 when water level was 2 feet below conservation elevation, the predominant substrate at the land-water interface was rock, with flooded terrestrial vegetation occurring at 67.8% of the sampling locations (Table 5).

Creel: Largemouth bass remained the most commonly targeted species by anglers. From January-June 2012, 95.2 % of the total angling was directed for largemouth bass (Table 6). Angling effort directed for white bass and catfishes comprised 1.3% and 1.1%, respectively, of the total angling effort occurring on the reservoir during the 6-month survey period. The recreational fishery at the reservoir continues to have a high economic value. From January-June 2012, the fishery generated $4.3 million in direct expenditures (Table 7). Anglers from 13 different states besides Texas fished the reservoir from January-June 2012.

Prey species: Gizzard shad relative abundance was low in 2011 and the population was comprised mostly of large individuals (>10 inches). Gizzard shad CPUE was 16.5 fish/h in 2011, which was down from 37.0 fish/h in 2007 and 65.5 fish/h in 2003 (Figure 3). Gizzard shad IOV continued to be very low (3 in 2011) indicating few individuals were of sufficient size to be utilized as prey. Similarly, bluegill relative abundance was low in 2011 (Figure 4). Bluegill CPUE was 16.0 fish/h in 2011, which was down from 90.0 fish/h in 2007 and 518.0 fish/h in 2003. Nearly all bluegill were a sufficient size to be available to predators (< 6 inches total length, TL). Redbreast sunfish (Figure 5) relative abundance, however, was substantially greater in 2011 (103.0 fish/h) than in 2007 (67.0 fish/h), but remained below that found in 2003 (259.5 fish/h). Other fishes collected in 2011 (Appendix B) and crayfish likely contribute to the forage base. Although relative abundance was low for some prey species in 2011, overall prey abundance was sufficient to support existing populations of predator fishes.

Catfishes: The reservoir supports sparse populations of channel, blue and flathead catfish. Relative abundance was $\leq$1.5 fish/nn for all three species in 2008, 2011, and 2012 (Figures 6-8). Blue catfish were not collected in 2012. For blue and channel catfishes combined, total fish and fish $\geq$12 inches CPUEs were slightly lower than historic average CPUEs (Figure 9). Channel catfish PSD was $\geq$81 and the largest individual collected during the study period was 26 inches TL. Flathead catfish PSD was $\geq$75 during the study period and the largest individual collected was 36 inches TL. Catfishes angler effort, catch and harvest have declined since 2003 (Table 8). From January-June 2012 (6 months), catfishes angler effort was 3,191 h and harvest was 3,165 fish, whereas from March 2002 to February 2003 (12 months) catfishes angler effort and harvest was 24,888 h and 17,188 fish, respectively. An insufficient number of catfish (N=1) were observed during creel interviews to conduct a length-frequency analysis of harvested fish.

White bass: White bass total CPUE ranged from 2.0-4.4 fish/nn during the study period (Figure 10). In two of three sample years (2008 and 2012), total fish CPUEs were greater than the historic average CPUE (Figure 11). Similarly, CPUEs for white bass >10 inches were similar or exceeded average CPUE. White bass PSD ranged from 71-80. White bass mean relative weight values declined as length increased for two of the sample years which suggests that forage availability may be limiting white bass abundance. White bass growth was moderate. Average age of 9-11 inch TL fish was 2.4 years in 2011 (N = 11) and 2.0 years in 2012 (N = 8). White bass angler effort, catch and harvest have declined since 2003 (Table 9). From January-June 2012 (6 months), white bass angler effort was 3,852 h and harvest was 5,544 fish, whereas from March 2002 to February 2003 (12 months) angler effort and harvest was 14,245 h and 34,566 fish, respectively. The most common size white bass harvested was 16 inches in 2012 (Figure 12).

Striped bass: Striped bass CPUE varied during the study period, ranging from 1.4 fish/nn in 2008 to 0.1 fish/nn in 2011 (Figure 13). Striped bass total CPUE and CPUE of fish $\geq$18 inches in 2011 and 2012 were substantially lower than historic averages (Figure 14). Striped bass fingerlings were not available to stock in 2011. As such, population abundance may remain low in the near future. Striped bass angler effort, catch and harvest have declined since 2003 and 2007 (Table 10). From January-June 2012 (6 months), striped bass angler effort was 480 h and catch was 137 fish, whereas from March 2002 to February 2003 (12 months) angler effort and catch was 3,824 h and 5,156 fish, respectively. An insufficient number of striped bass (N=0) were observed during creel interviews to conduct a length-frequency analysis of harvested fish.

Largemouth bass: Relative abundance increased since 2006, but then decreased in recent years. Total largemouth bass CPUE in standard electrofishing surveys was 64.0 fish/h in 2011, considerably lower than in 2007 (105.0 fish/h, Figure 15). Total largemouth bass CPUE in bass-only electrofishing surveys was substantially greater in 2009 (126.0 fish/h) than in 2007 (72.4 fish/h) and 2006 (54.4 fish/h, Figure 16). Relative abundance of stock-size fish trended similarly. However, relative abundance of fish $\geq$14 inches in 2009 and 2011 was higher than the historic average (Figure 17). Population size structure remains improved since 2003 with PSD and PSD-P ranging from 56-70 and 29-32, respectively, since 2009. Average relative weights exceeded 85 for all size classes in 2009, however they slightly declined for larger fish in 2011. Although 1.01 million FLMB fingerlings were stocked from 2008 to 2011, overall genetic introgression (percent FLMB alleles) decreased from 82% in 2009 to 73% in 2011 (Table 11). Similarly, FLMB genotype fish comprised a lower portion of the population, from 23% in 2009 to 7% in 2011. Largemouth bass growth rate was variable during the study period. Average age of 13-15 inch TL fish was 1.9 years in 2009 and 2.8 years in 2011. The simulation model revealed that if a 3-fish instead of 5-fish bag limit was in effect in 2007, 10.0% less fish (3,017) would have been retained by tournament anglers and 13.9% less fish (3,199) would have been harvested by non-tournament anglers (Appendix C). Assuming that 28% of tournament-retained fish suffer mortality (average tournament mortality, Wilde 1998), these decreases represents a 7.4% overall decline in the number of fish deaths (3,953) due to these sources. Reducing the daily bag limit to 3 fish would only minimally impact harvest and the largemouth bass population. Angler effort directed at largemouth bass in 2012 (281,150 h in 6 months) remained similar to or slightly less than in 2007 (601,747 h in 12 months) when the fishery was at its peak (Table 12). Tournament angler effort represented 38% of total largemouth bass angler effort in all of 2007, whereas it represented 33% of total effort in the first half of 2012. Anglers caught and released more legal-size fish during the 6-month 2012 period (160,783 fish) than in all of 2007 (148,899 fish). More largemouth bass were weighed-in by tournament anglers during the 2012 6-month period (35,954 fish) than during all of 2007 (30,508 fish). Harvest by non-tournament anglers in the 2012 6-month period (23,342 fish) was only slightly below that occurring in all of 2007 (26,100 fish). The most common size largemouth bass harvested was 15-16 inches (Figure 18). The reservoir continues to produce a high number of trophy fish. During the first six months of 2012, an estimated 93 fish exceeding 10 lbs. were caught and released.

Fisheries Management Plan for Amistad Reservoir

Prepared July 2012.

ISSUE 1: Striped bass are a popular sport fish at Amistad Reservoir. Annual stocking is required to maintain the population because this species does not successfully reproduce in Amistad Reservoir.

MANAGEMENT STRATEGY

1. Stock striped bass annually at 3-5 fish/acre.

ISSUE 2: Amistad is revered for its high quality largemouth bass fishery and for catches of trophy-size fish. The reservoir was ranked as the 6th best largemouth bass fishing destination in 2012 by ESPN-Bassmaster. It has produced a total of 12 ShareLunkers, five of which were caught between 2008 and 2012. In 2007, 136 largemouth bass weighing >10 lbs and 1,501 fish weighing between 7 and 10 lbs were caught and released by anglers.

MANAGEMENT STRATEGY

1. Annually stock at least 250,000 FLMB fingerlings to maintain a high level Florida bass introgression production of trophy fish.

ISSUE 3: Many invasive species threaten aquatic habitats and organisms in Texas and can adversely affect the state ecologically, environmentally, and economically. For example, zebra mussels (*Dreissena polymorpha*) can multiply rapidly and attach themselves to any available hard structure, restricting water flow in pipes, fouling swimming beaches and plugging engine cooling systems. Giant Salvinia (*Salvinia molesta*) and other invasive vegetation species can form dense mats, interfering with recreational activities like fishing, boating, skiing and swimming. The financial costs of controlling and/or eradicating these types of invasive species are significant. Additionally, the potential for invasive species to spread to other river drainages and reservoirs via watercraft and other means is a serious threat to all public waters of the state.

MANAGEMENT STRATEGIES

1. Cooperate with the controlling authority to post appropriate signage at access points around the reservoir.
2. Contact and educate marina owners about invasive species, and provide them with posters, literature, etc… so that they can in turn educate their customers.
3. Educate the public about invasive species through the use of media and the internet.
4. Make a speaking point about invasive species when presenting to constituent and user groups.
5. Keep track of (i.e., map) existing and future inter-basin water transfers to facilitate potential invasive species responses.

SAMPLING SCHEDULE JUSTIFICATION:

Biennial electrofishing surveys are necessary to monitor the largemouth bass population. Conduct additional largemouth bass only electrofishing in 2013. Biennial gill net sampling is necessary to monitor the striped bass population. In addition to the required gill net survey in 2016, conduct a gill net survey in 2014 (Table 13).

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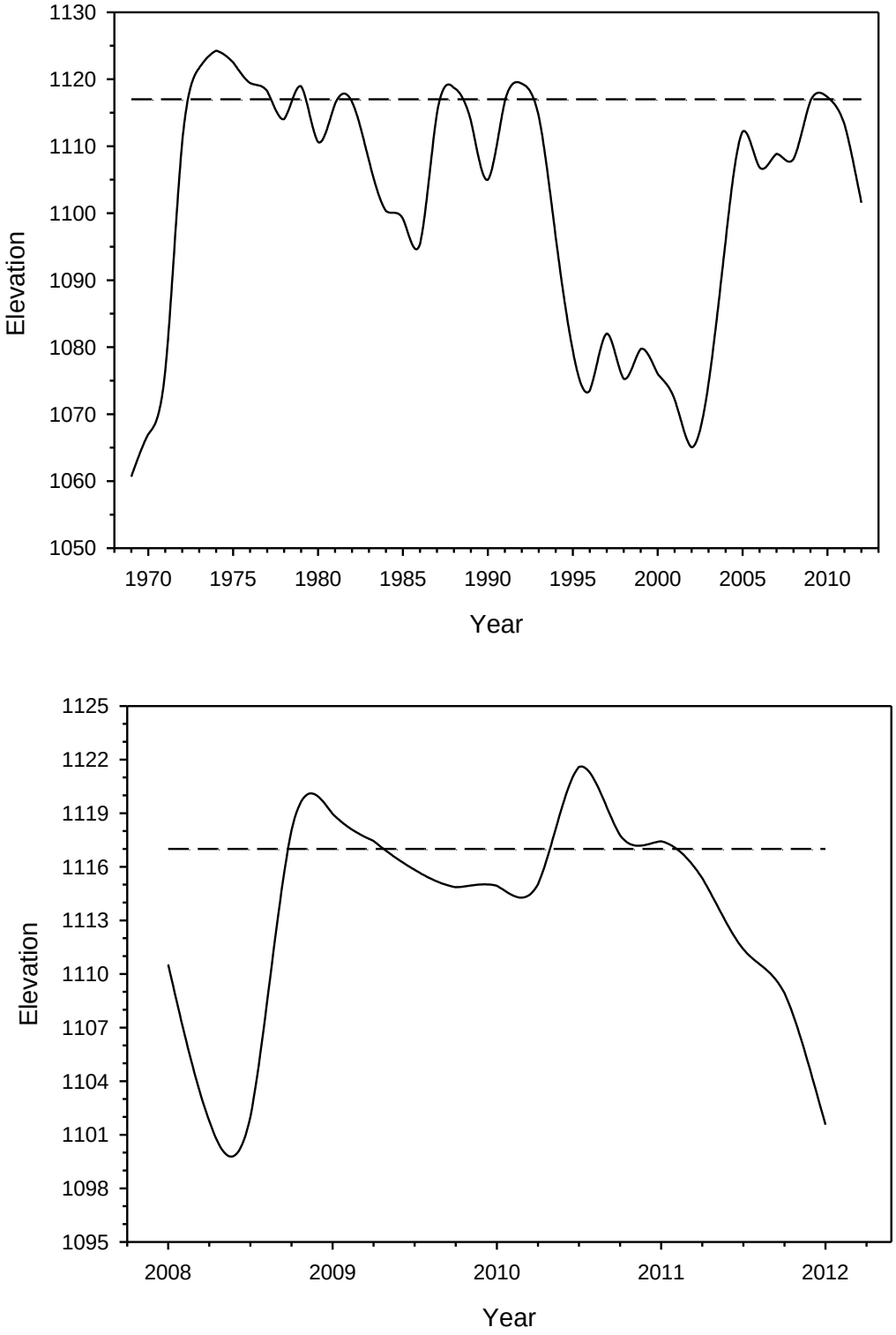


Figure 1. Average annual water level elevation in feet above mean sea level (MSL) since 1969 (top panel) and quarterly average water level elevation during the study period (bottom panel) for Amistad Reservoir, Texas. Conservation pool elevation is 1,117 feet MSL and is represented by the horizontal dashed line.

Table 1. Characteristics of Amistad Reservoir, Texas.

Characteristic	Description
Year constructed	1969
Controlling authority	International Boundary and Water Commission
County	Val Verde
Reservoir type	Mainstream
Shoreline Development Index	23.47
Conductivity	871 µmhos/cm

Table 2. Fish harvest regulations for Amistad Reservoir.

Species	Bag Limit	Minimum length limit (inches)
Catfish: channel and blue catfish, their hybrids and subspecies	25 (in any combination)	12
Catfish, flathead	5	18
Bass, striped	5	18
Bass, largemouth and smallmouth	5 (in any combination)	14
Bass, white	25	10
Crappie: white and black crappie, their hybrids and subspecies	25 (in any combination)	10

Table 3. Stocking history of Amistad Reservoir, Texas. Size categories are: FRY = <1 inch; FGL = 1-3 inches; and ADL = adults.

Species	Year	Number	Size
Northern pike	1976	1,030,305	FRY
Muskellunge	1976	700	FGL
Blue catfish	1967	5,445	FGL
Channel catfish	1967	22,650	FGL
	1968	317,695	FGL
	1969	77,025	FGL
	1971	8,000	FGL
	1972	10,100	FGL
	1973	50,550	FGL
	Total	486,020	
Striped bass	1974	13,198	FGL
	1976	62,992	FGL
	1977	693,107	FGL
	1978	204,891	FGL
	1979	255,000	FGL
	1980	12,000	FGL
	1982	101,000	FGL
	1984	649,289	FGL
	1986	180,770	FGL
	1988	850,000	FGL
	1991	252,371	FGL
	1992	339,369	FGL
	1993	657,937	FGL
	1994	1,316,638	FGL
	1995	100,259	FGL
	1997	67,463	FGL
	1998	67,885	FGL
	1999	67,800	FGL
	2000	184,113	FGL
	2002	133,800	FGL
	2004	233,111	FGL
	2005	318,908	FGL
	2006	120,085	FGL
	2007	127,685	FGL
	2008	140,348	FGL
	2009	184,494	FGL
	2010	152,998	FGL
	Total	7,334,513	
Palmetto bass	1975	171,300	FGL
	1976	173,662	FGL
	1982	1,270,000	FGL
	Total	1,614,962	
Smallmouth bass	1975	100,000	FGL
	1976	200,000	FGL
	1978	164,750	FGL

Table 3 continued. Stocking history of Amistad Reservoir, Texas. Size categories are: FRY ≤1 inch; FGL = 1-3 inches, and ADL = adults.

Species	Year	Number	Size
Smallmouth bass continued	1983	200,500	FGL
	Total	665,250	
Largemouth bass	1967	1,053,750	FGL
	1968	928,425	FGL
	1969	810,700	FGL
	1971	446,600	FGL
	1972	100	ADL
	1973	1,050	ADL
	2004	42,077	FGL
	2005	289,666	FGL
	Total	3,530,351	
Florida largemouth bass	1975	50,000	FGL
	1976	88,000	FGL
	1977	70,000	FGL
	1978	158,000	FGL
	1979	300,000	FGL
	980	214,700	FGL
	1992	507,075	FGL
	1996	130,768	FGL
	1997	272,262	FGL
	2004	552,648	FGL
	2006*	4,519	FGL
	2008	501,874	FGL
	2008*	2,614	FGL
	2010	252,550	FGL
	2010*	2,081	FGL
	2011	252,283	FGL
	2012	269,075	
	Total	3,628,449	
White crappie	1968	17,393,000	FRY
Walleye	1975	5,250,000	FRY
	1976	5,100,000	FRY
	1977	2,033,000	FRY
	1978	5,000,000	FRY
	Total	17,383,000	FRY

* ShareLunker largemouth bass

Table 4. Results of vegetation surveys conducted at Amistad Reservoir in August 2008 and 2011. Minimum and maximum depth located (feet) and percent occurrence (PO) with lower and upper 95% confidence limits (CL) are shown by vegetation species or species group. Sampling occurred at 319 and 421 random points in 2008 and 2011, respectively, on the Texas side of the reservoir which encompasses 34,312 acres when water level is at conservation pool elevation (1,117 feet). Water level at time of survey was 1,099 feet (18 feet low) in 2008 and 1,112 feet (5 feet low) in 2011. NF = not found.

	Min. depth		Max. depth		PO (CL)	
Species/species group	2008	2011	2008	2011	2008	2011
Chara	2	1	26	25	13.5 (9.7-17.2)	10.2 (7.5-13.5)
Hydrilla	2	1	27	24	19.8 (15.4-24.1)	5.2 (3.3-7.8)
American pondweed	2	1	13	5	1.8 (0.4-3.3)	0.5 (0.3-0.8)
Curly-leaf pondweed	2	1	22	20	6.0 (3.3-8.6)	11.1 (8.3-14.6)
Sago pondweed	2	1	15	25	6.9 (4.1-9.7)	4.8 (2.9-7.2)
Combined pondweed spp.	2	1	22	25	10.7 (7.3-14.0)	12.3 (9.4-15.9)
Water star grass	4	NF	10	NF	0.9 (0.0-2.0)	0.0
Naiad spp.	3	14	10	14	0.6 (0.0-1.5)	<0.5 (0.0-0.7)
Bladderwort spp.	2	NF	20	NF	0.9 (0.0-2.0)	0.0
Combined vegetation	2	1	27	25	28.8 (23.8-33.8)	18.5 (14.9-22.6)

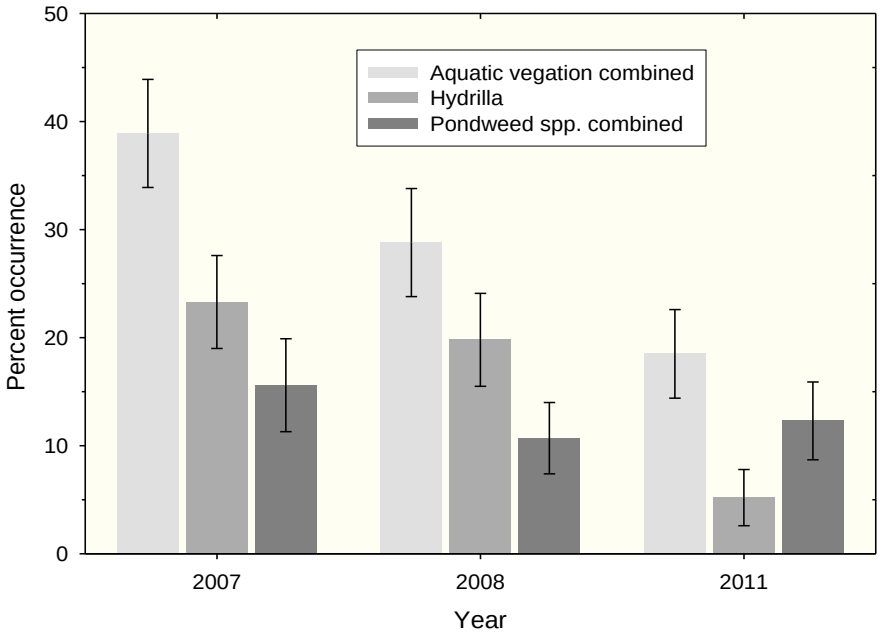


Figure 2. Percent occurrence of aquatic vegetation combined, hydrilla, and pondweed spp. combined at Amistad Reservoir (Texas side) in 2007-2008, and 2011.

Table 5. Results of shoreline structural habitat survey conducted in March 2010. Percent occurrence (PO) with lower and upper 95% confidence limits (CL) is shown by habitat type. Sampling occurred at 397 random shoreline locations on the Texas side of the reservoir. Water level at time of survey was 2 feet below conservation elevation.

Shoreline structural habitat type	PO	Lower CL	Upper CL
Rocky	70.3	65.6	74.7
Rock and boulders	14.9	11.5	18.8
Gravel	9.3	6.5	12.1
Natural	2.5	1.2	4.6
Piers and docks	0.3	0.0	0.7
Flooded terrestrial vegetation	67.8	62.9	72.3

Table 6. Percent directed angler effort by species for Amistad Reservoir, Texas. The 2003 creel was conducted from 3/1/2002 to 2/28/2003 (12 months). The 2007 creel was conducted from 1/1/2007 to 12/31/2007 (12 months). The 2012 creel was conducted from 1/1/2012 to 6/30/2012 (6 months).

Species	Year		
	2003	2007	2012
Catfishes	7.9	3.1	1.1
White bass	4.4	0.7	1.3
Striped bass	1.4	<0.1	0.2
Sunfishes	0.0	0.1	0.0
Largemouth bass	83.0	93.5	95.2
Black and white crappie	0.2	0.0	0.0
Other and anything	3.1	2.6	2.2

Table 7. Total fishing effort (hours) for all species and total directed expenditures ($US, millions) at Amistad Reservoir, Texas. The 2003 creel was conducted from 3/1/2002 to 2/28/2003 (12 months). The 2007 creel was conducted from 1/1/2007 to 12/31/2007 (12 months). The 2012 creel was conducted from 1/1/2012 to 6/30/2012 (6 months).

Creel Statistic	Year		
	2003	2007	2012
Total fishing effort	320,917	643,506	295,314
Total direct expenditures	5.4[1]	14.6[2]	4.3[3]

[1] per Bradle et al. 2003; [2] per Shuett et al. 2012; [3] per TPWD creel survey studies

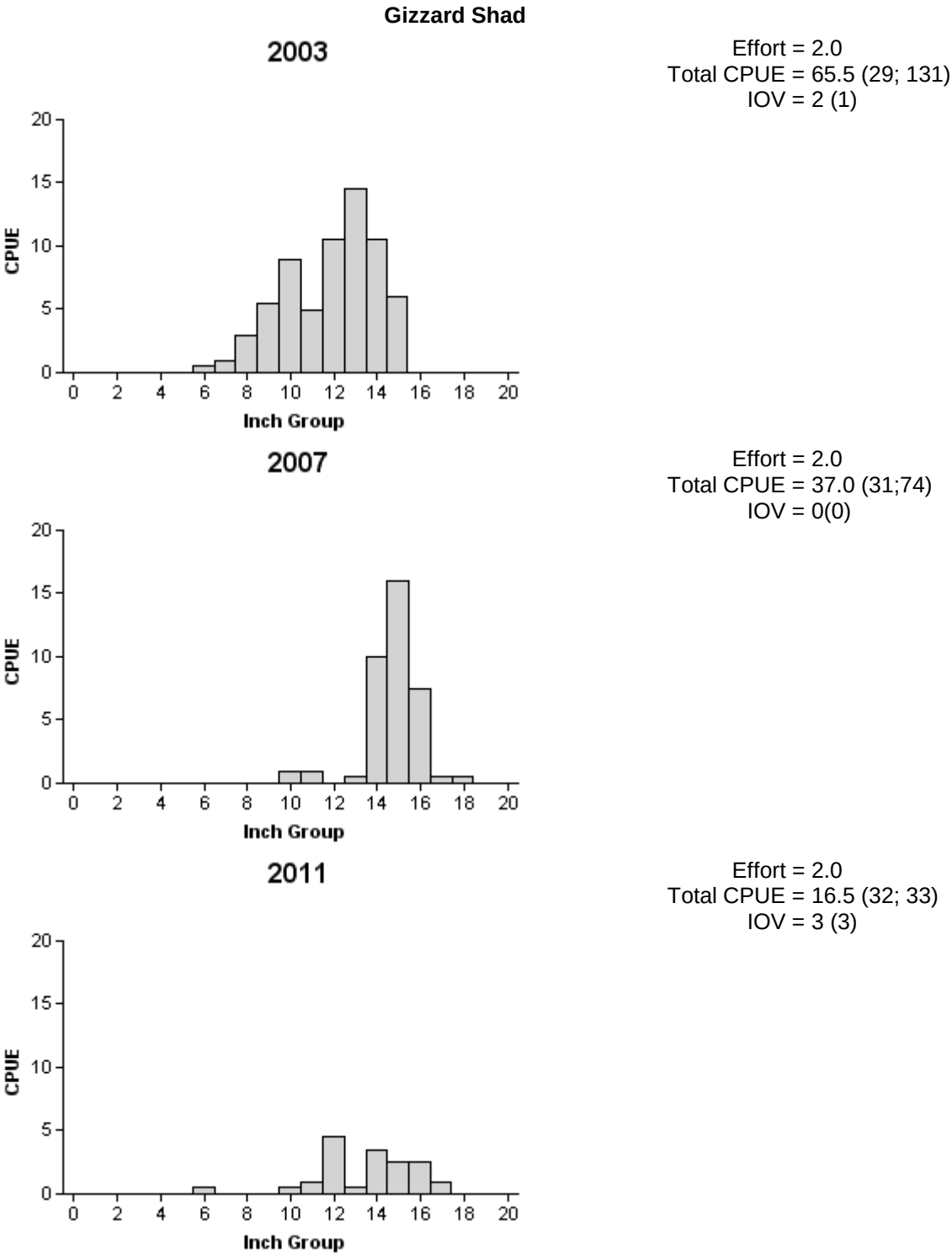


Figure 3. Number of gizzard shad caught per hour (CPUE) and population indices (RSE and N are in parentheses) for fall electrofishing surveys, Amistad Reservoir, Texas, 2003, 2007, and 2011. RSE is used for CPUE values and SE is used for IOV values.

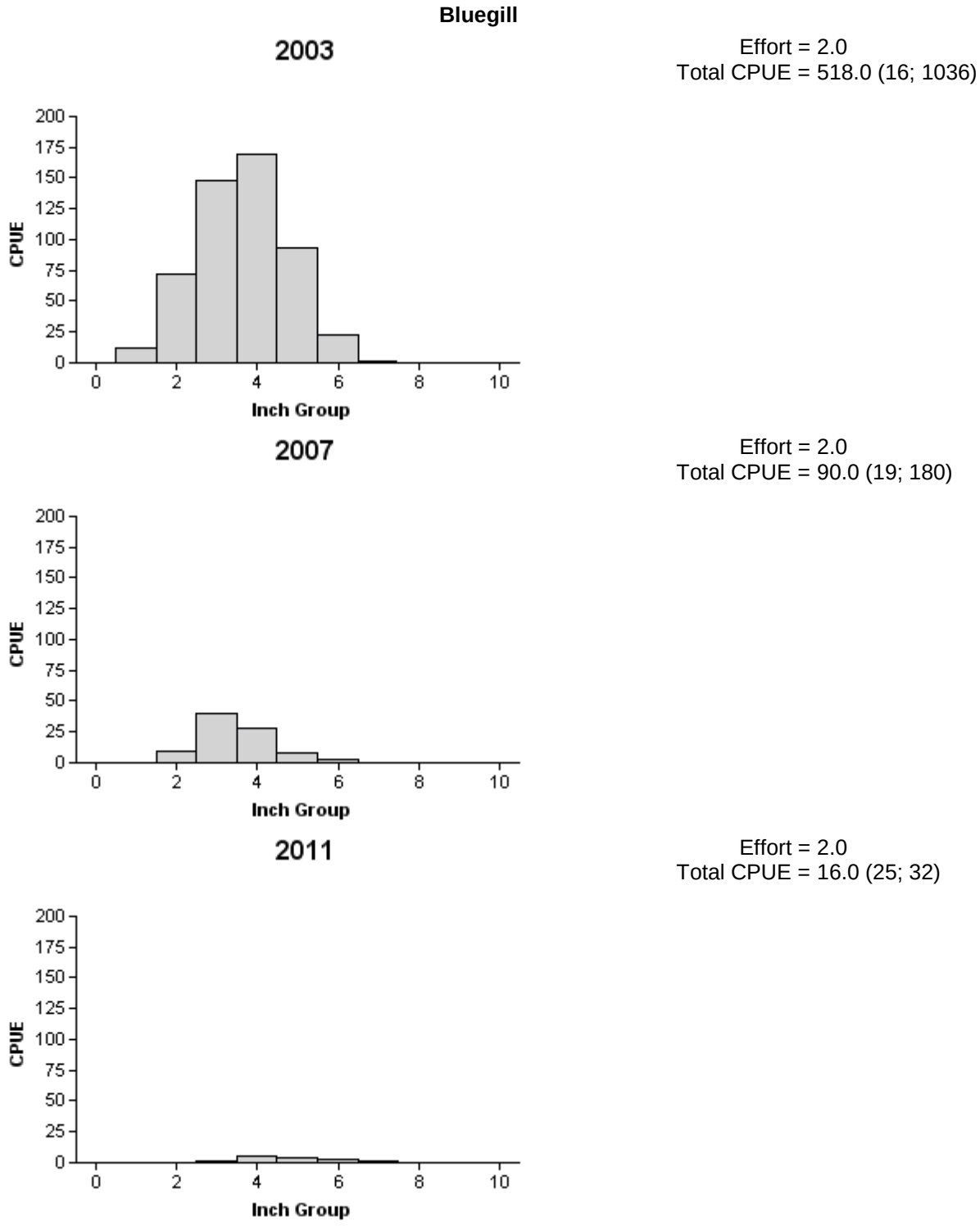


Figure 4. Number of bluegill caught per hour (CPUE) for fall electrofishing surveys, Amistad Reservoir, Texas, 2003, 2007, and 2011. RSE and N are in parentheses.

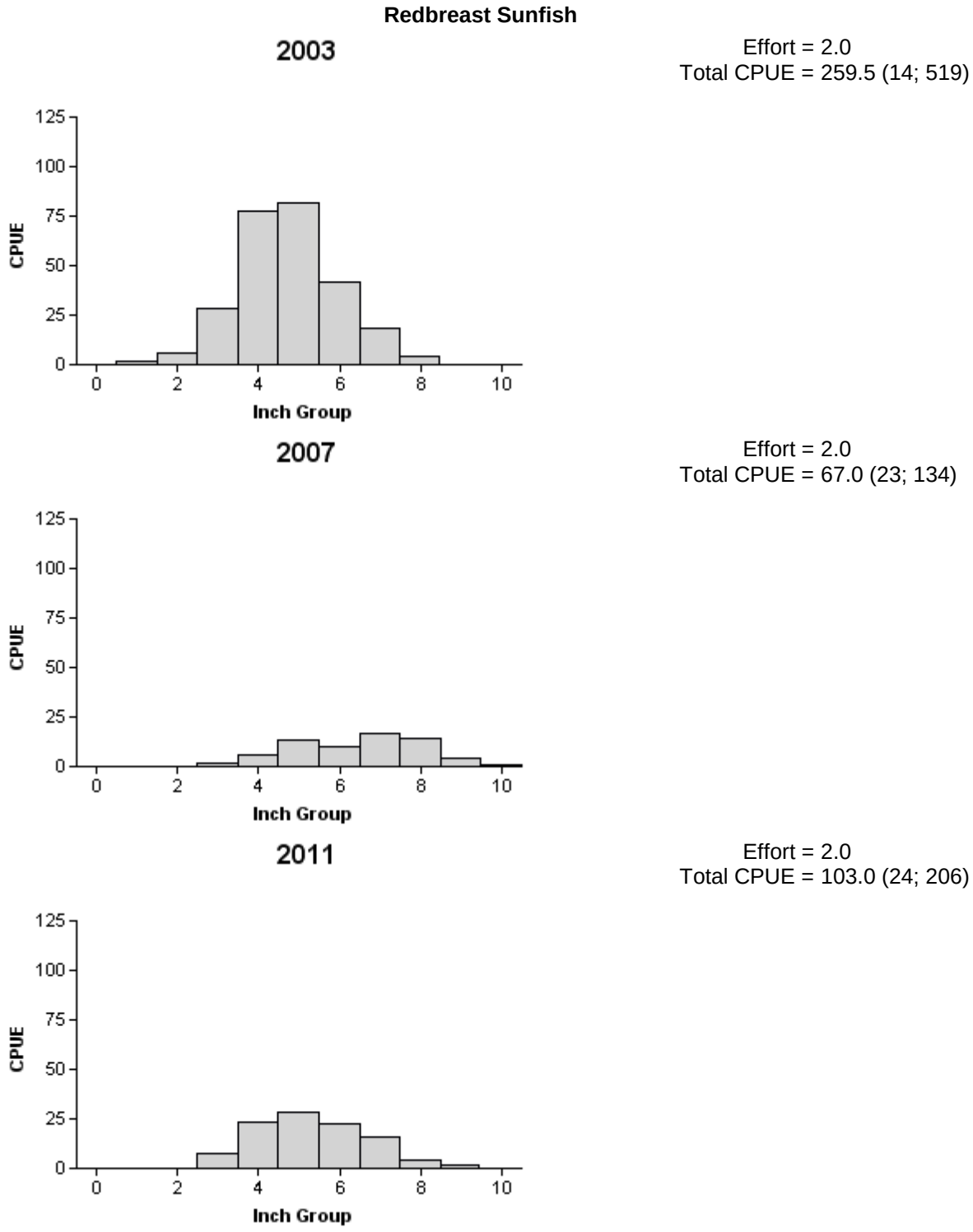


Figure 5. Number of redbreast sunfish caught per hour (CPUE) for fall electrofishing surveys, Amistad Reservoir, Texas, 2003, 2007, and 2011. RSE and N are in parentheses.

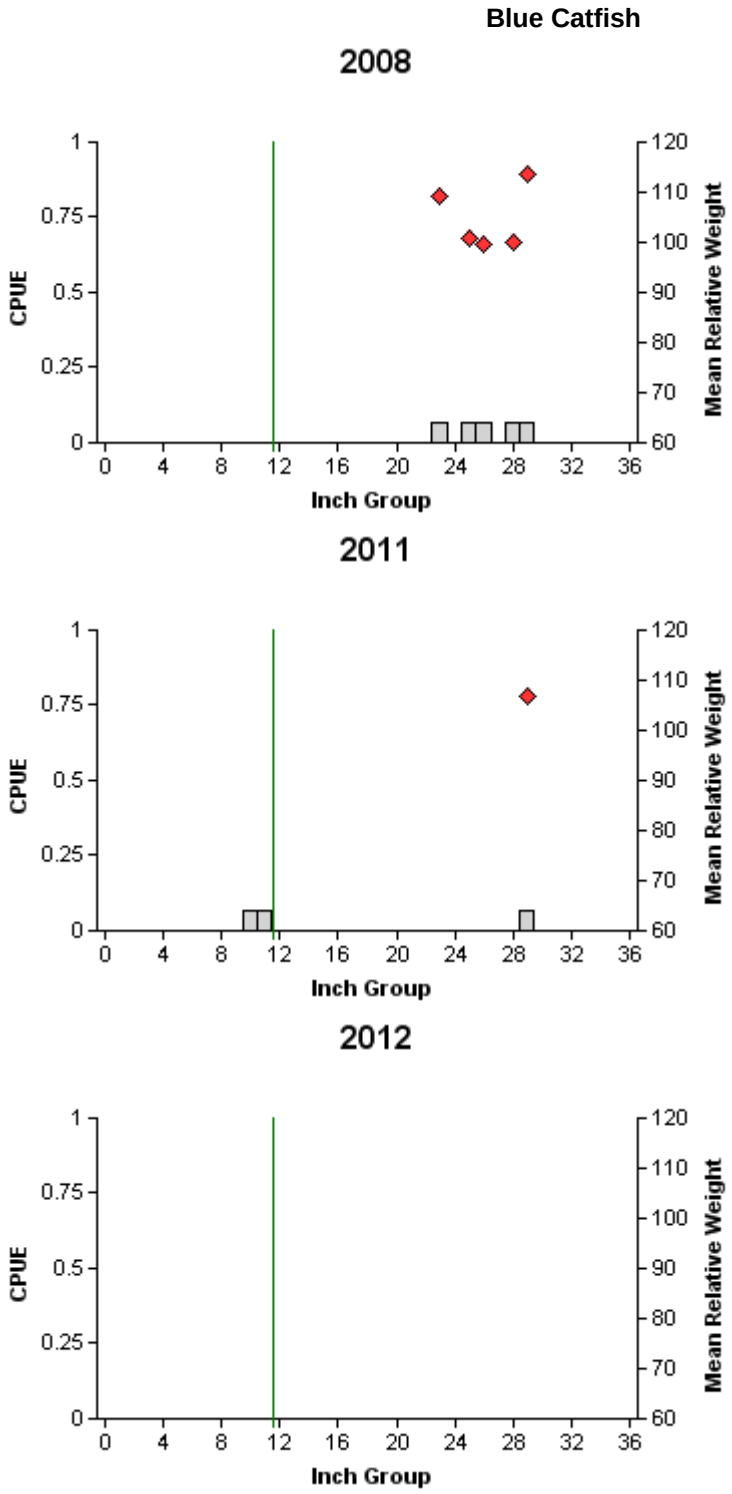


Figure 6. Number of blue catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for spring gill net surveys, Amistad Reservoir, Texas, 2008, 2011, and 2012. RSE is used for CPUE values and SE is used for PSD values. Vertical line represents the minimum length limit.

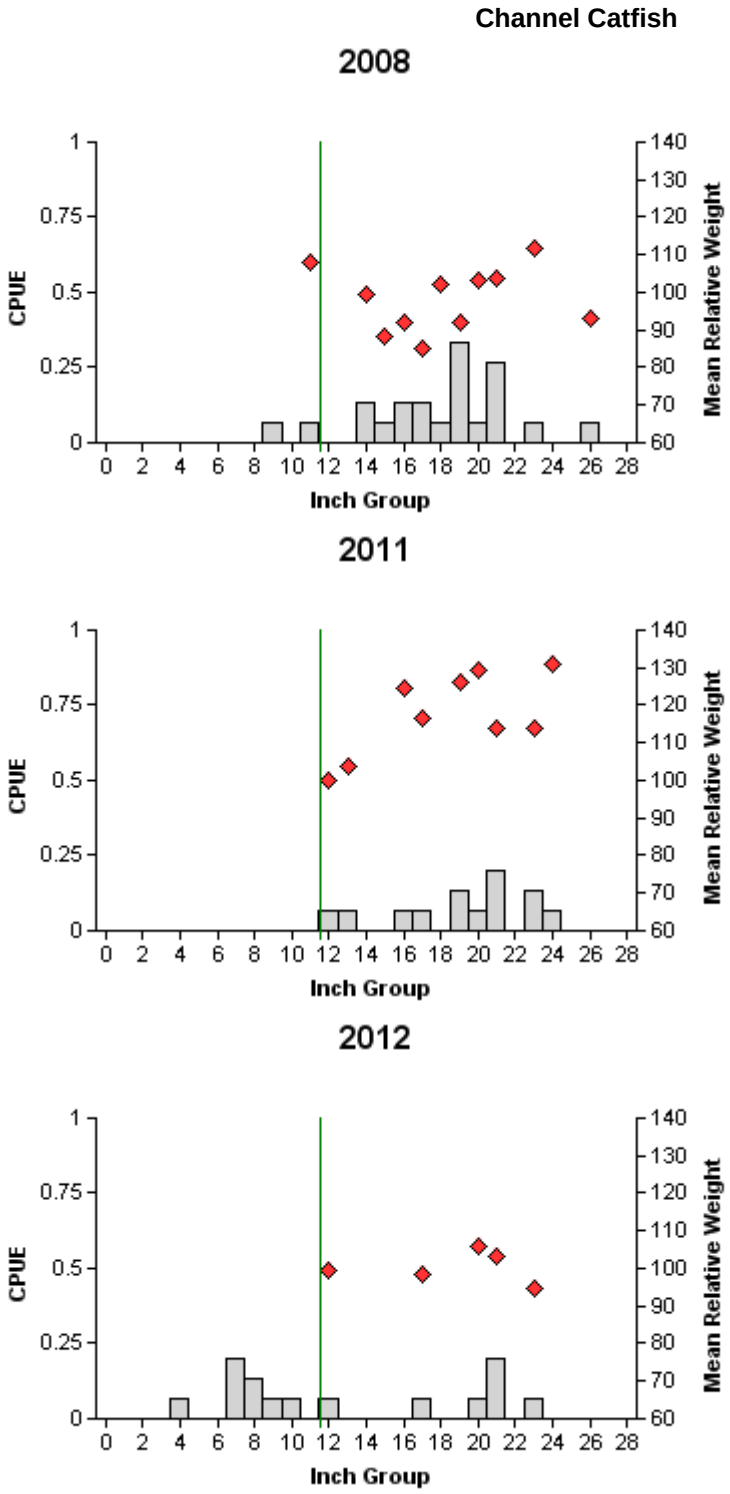


Figure 7. Number of channel catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for spring gill net surveys, Amistad Reservoir, Texas, 2008, 2011, and 2012. RSE is used for CPUE values and SE is used for PSD values. Vertical line represents the minimum length limit.

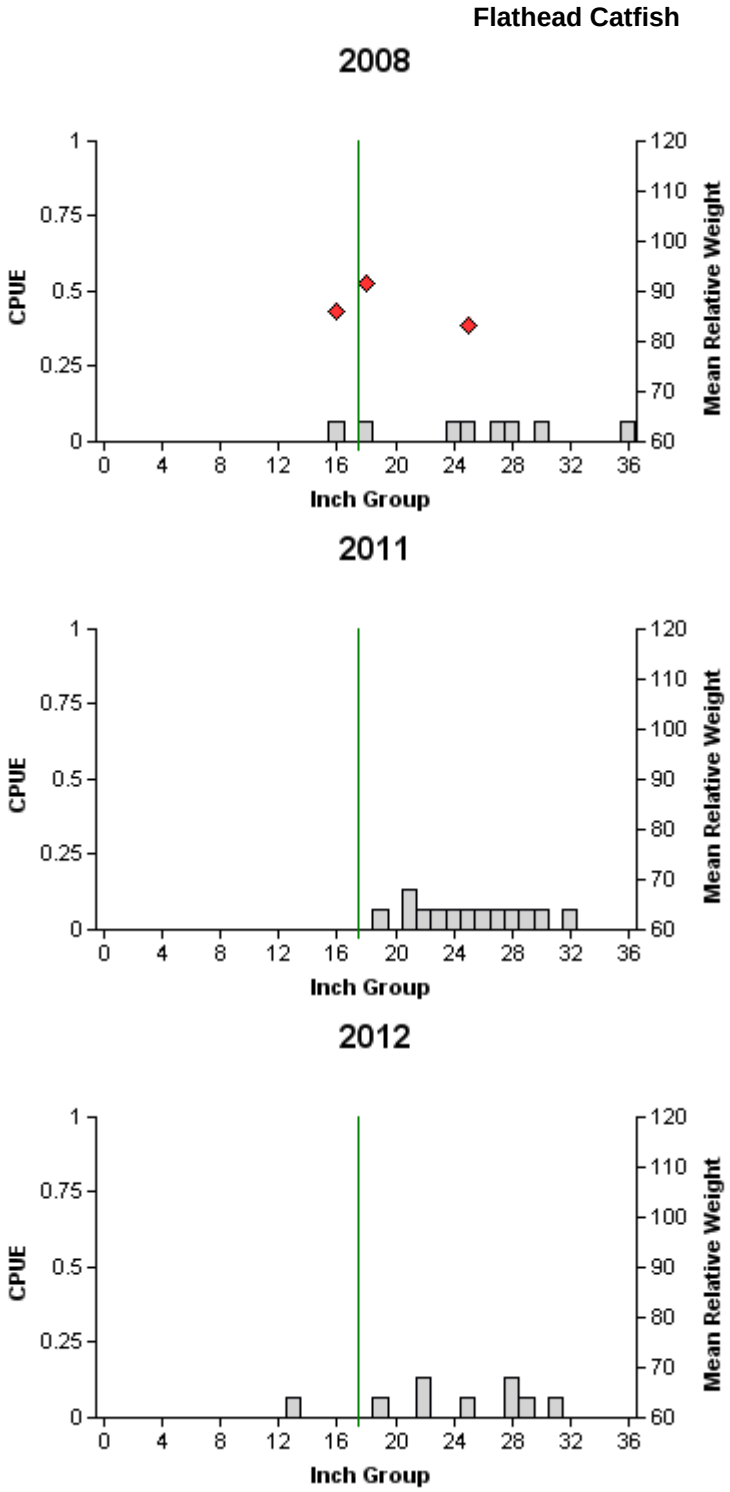


Figure 7. Number of flathead catfish caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for spring gill net surveys, Amistad Reservoir, Texas, 2008, 2011, and 2012. RSE is used for CPUE values and SE is used for PSD values. Weights were unable to be recorded for fish collected in 2011 and 2012. Vertical line represents the minimum length limit.

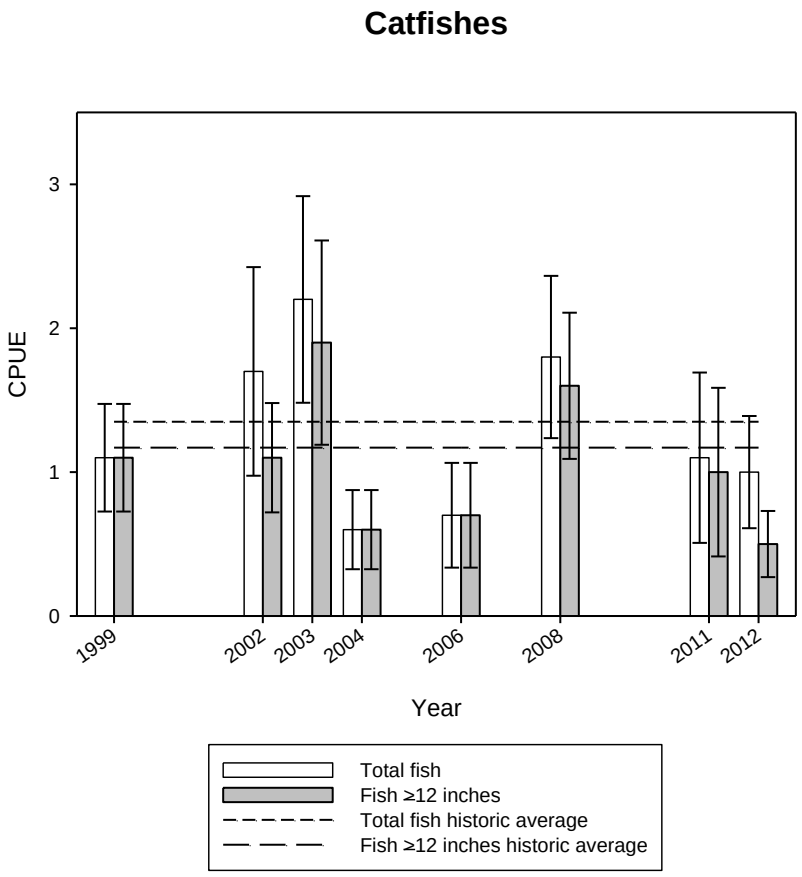


Figure 9. Total number of channel and blue catfishes combined and number ≥12 inches caught per net-night of gill net sampling (CPUE) since 1999. Historic average CPUEs (represented by the dashed lines) were calculated using CPUEs determined prior to the current study period. The error bars represent ± one standard error.

Table 8. Summary creel results for catfishes at Amistad Reservoir. The 2003 creel was conducted from 3/1/2002 to 2/28/2003 (12 months). The 2007 creel was conducted from 1/1/2007 to 12/31/2007 (12 months). The 2012 creel was conducted from 1/1/2012 to 6/30/2012 (6 months). Angling effort was estimated for anglers specifically targeting these species. Total harvest and total catch estimates include catfishes caught by anglers targeting these species and by anglers targeting other species. HPUE and CPUE is the average number of fish harvested and caught, respectively, per one-hour angling effort by anglers targeting catfishes. Voluntary release rate is the percentage of legal-size fish (>12 inches for channel and blue catfishes and >18 inches for flathead catfish) caught and released.

Creel statistic	2003	2007	2012
Angling effort (hours):			
Catfishes combined	24,888	20,067	3,191
Harvest (number of fish):			
Channel catfish	15,220	5,077	2,696
Blue catfish	263	0	469
Flathead catfish	1,635	98	0
Catfishes combined	17,188	5,175	3,165
Catch (number of fish):			
Channel catfish	24,746	5,077	2,696
Blue catfish	306	0	469
Flathead catfish	2,361	98	0
Unidentified catfish	0	740	0
Catfishes combined	27,413	5,915	3,165
Voluntary release rate			
Catfishes combined	3.4	15.3	0.0
HPUE:			
Catfishes combined	0.69	0.26	0.73
CPUE:			
Catfishes combined	1.1	0.29	0.73

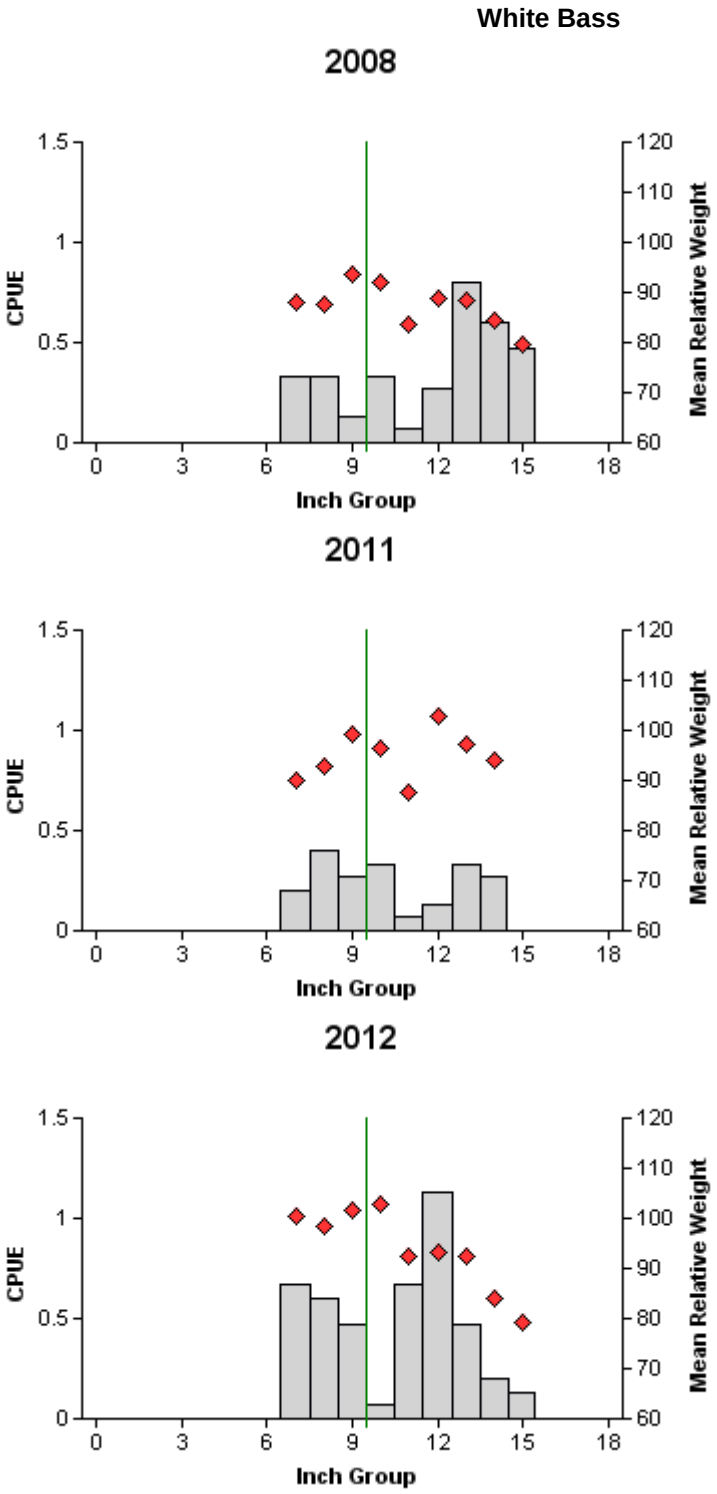


Figure 10. Number of white bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for spring gill net surveys, Amistad Reservoir, Texas, 2008, 2011, and 2012. RSE is used for CPUE values and SE is used for PSD values. Vertical line represents the minimum length limit.

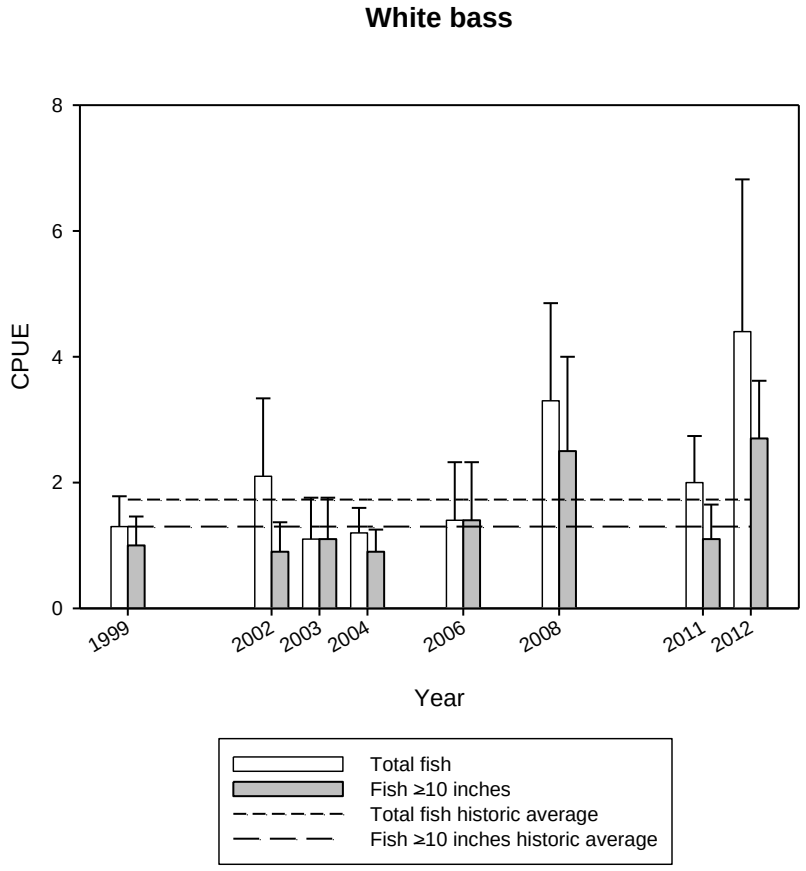


Figure 11. Total number of white bass and number ≥10 inches caught per net-night of gill net sampling (CPUE) since 1999. Historic average CPUEs (represented by the dashed lines) were calculated using CPUEs determined prior to the current study period. The error bars represent ± one standard error.

Table 9. Summary creel results for white bass at Amistad Reservoir. The 2003 creel was conducted from 3/1/2002 to 2/28/2003 (12 months). The 2007 creel was conducted from 1/1/2007 to 12/31/2007 (12 months). The 2012 creel was conducted from 1/1/2012 to 6/30/2012 (6 months). Angling effort was estimated for anglers specifically targeting this species. Total harvest and total catch estimates include white bass caught by anglers targeting this species and by anglers targeting other species. HPUE and CPUE is the average number of white bass harvested and caught, respectively, per one-hour angling effort by anglers targeting this species. Voluntary release rate is the percentage of legal-size fish (>10 inches) caught and released.

Creel statistic	2003	2007	2012
Angling effort (hours)	14,245	4,539	3,852
Total harvest (number of fish)	34,566	5,881	5,544
Total catch (number of fish)	45,459	6,872	6,424
Voluntary release rate	<1.0	5.8	13.7
HPUE	1.30	0.60	1.03
CPUE	1.70	0.63	1.10

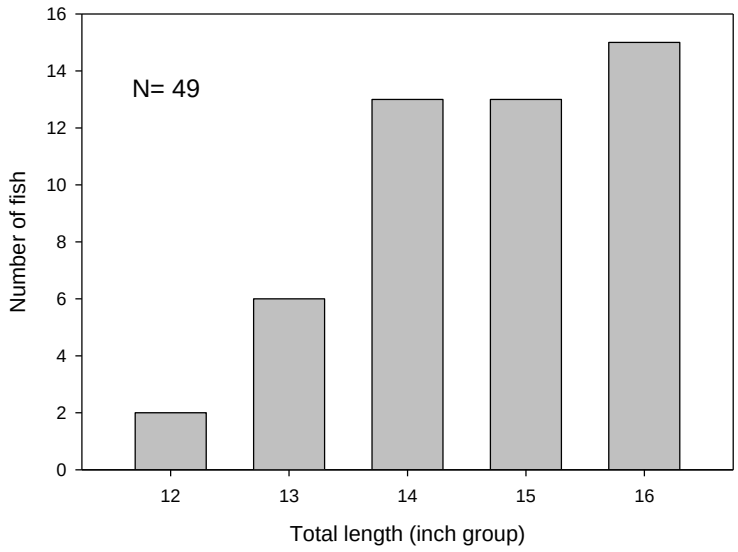


Figure 12. Length frequency distribution of white bass harvested by anglers from January through June 2012.

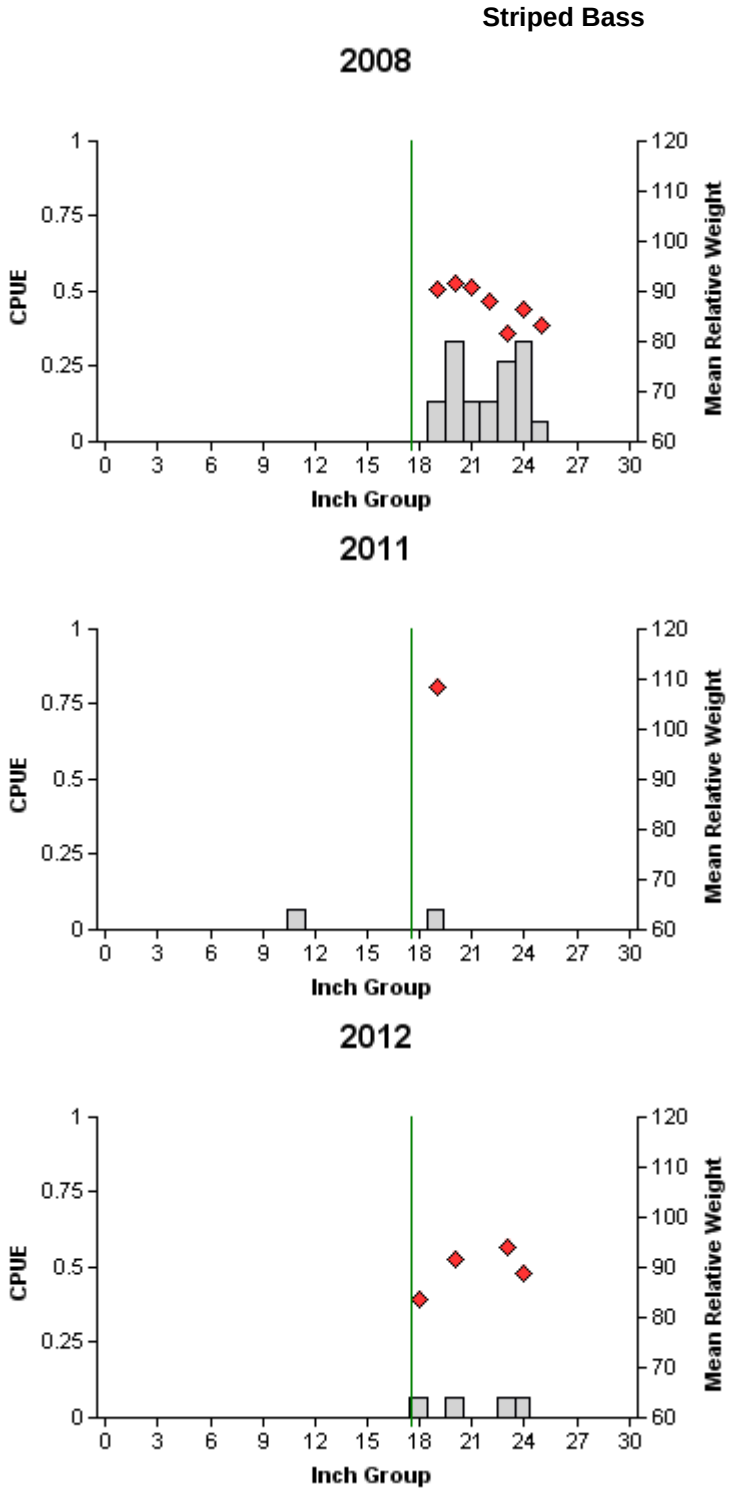


Figure 13. Number of striped bass caught per net night (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for spring gill net surveys, Amistad Reservoir, Texas, 2008, 2011, and 2012. RSE is used for CPUE values and SE is used for PSD values. Vertical line represents the minimum length limit.

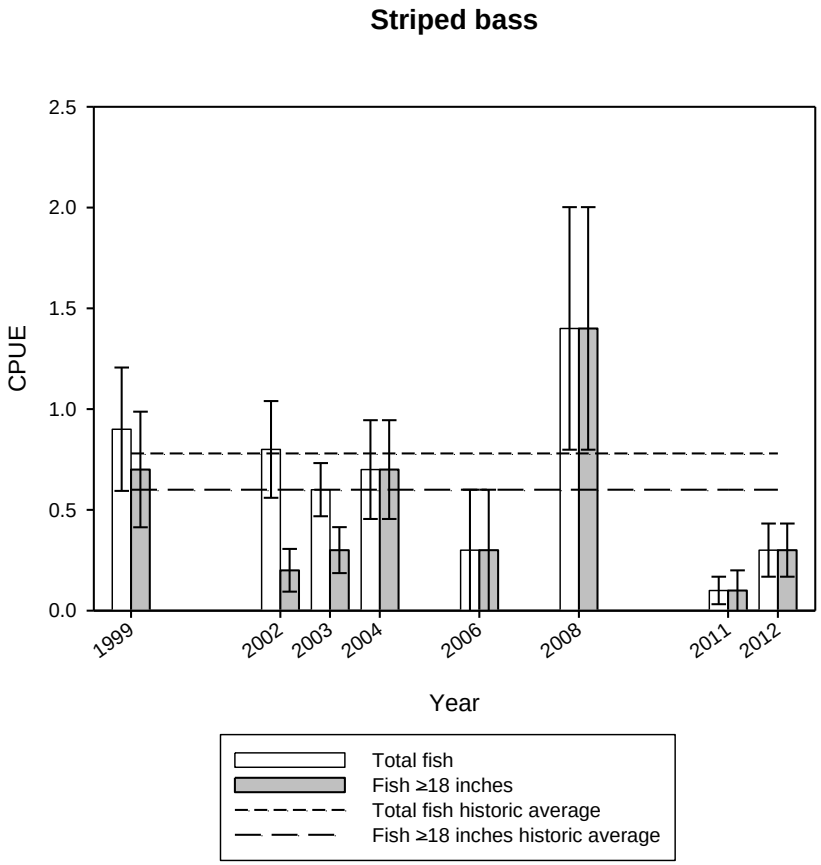


Figure 14. Total number of striped bass and number ≥18 inches caught per net-night of gill net sampling (CPUE) since 1999. Historic average CPUEs (represented by the dashed lines) were calculated using CPUEs determined prior to the current study period. The error bars represent ± one standard error.

Table 10. Summary creel results for striped bass at Amistad Reservoir. The 2003 creel was conducted from 3/1/2002 to 2/28/2003 (12 months). The 2007 creel was conducted from 1/1/2007 to 12/31/2007 (12 months). The 2012 creel was conducted from 1/1/2012 to 6/30/2012 (6 months). Angling effort was estimated for anglers specifically targeting striped bass. Total harvest and total catch estimates include striped bass caught by anglers targeting this species and by anglers targeting other species. HPUE and CPUE is the average number of fish harvested and caught, respectively, per one-hour angling effort by anglers targeting this species. Voluntary release rate is the percentage of legal-size fish (>18 inches) caught and released.

Creel statistic	2003	2007	2012
Angling effort (hours)	3,824	2,490	480
Harvest (number of fish)	2,191	3,151	0
Catch (number of fish)	5,156	5,748	137
Voluntary release rate	4.5	4.3	100
HPUE	0.34	0.60	0.0
CPUE	0.45	1.13	0.10

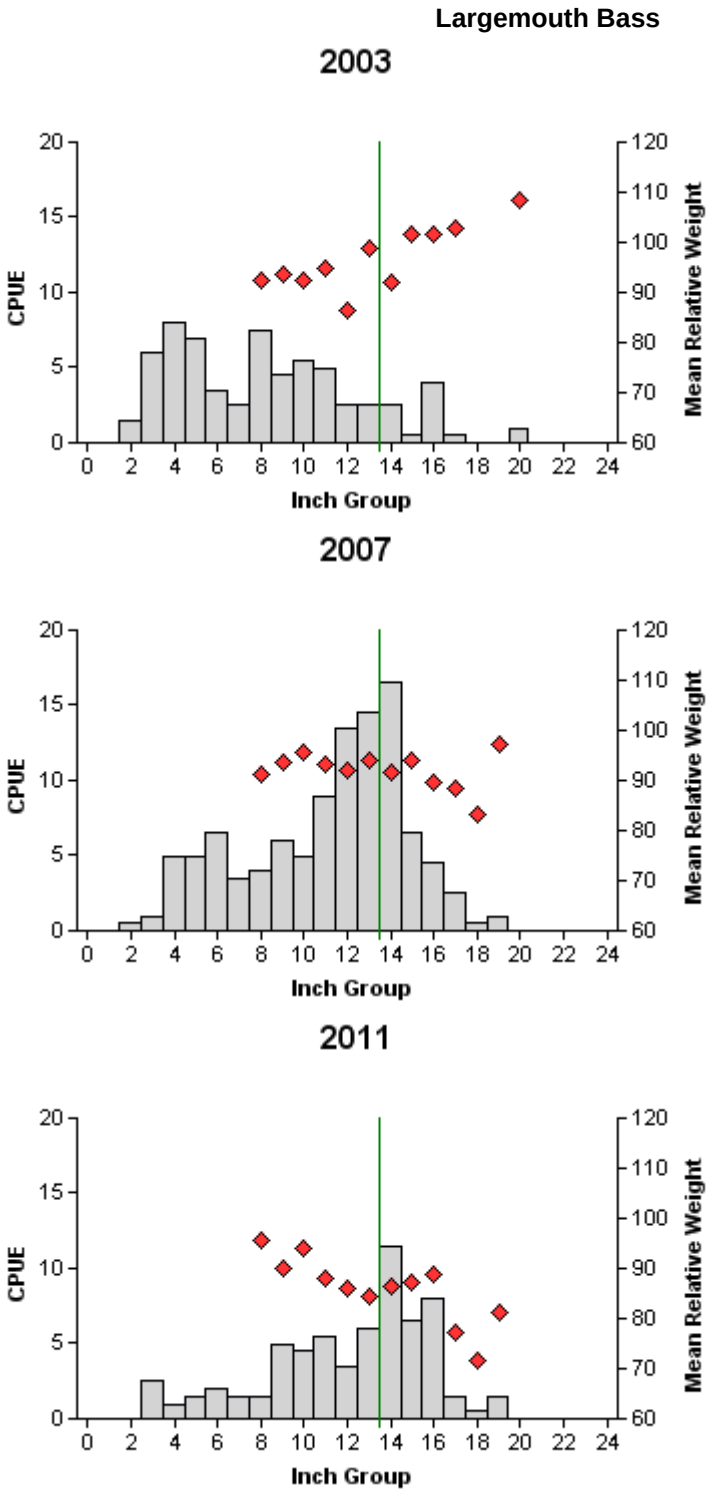


Figure 15. Number of largemouth bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for fall electrofishing surveys, Amistad Reservoir, Texas, 2003, 2007, and 2011. RSE is used for CPUE values and SE is used for RSD and PSD values. Vertical line represents the minimum length limit.

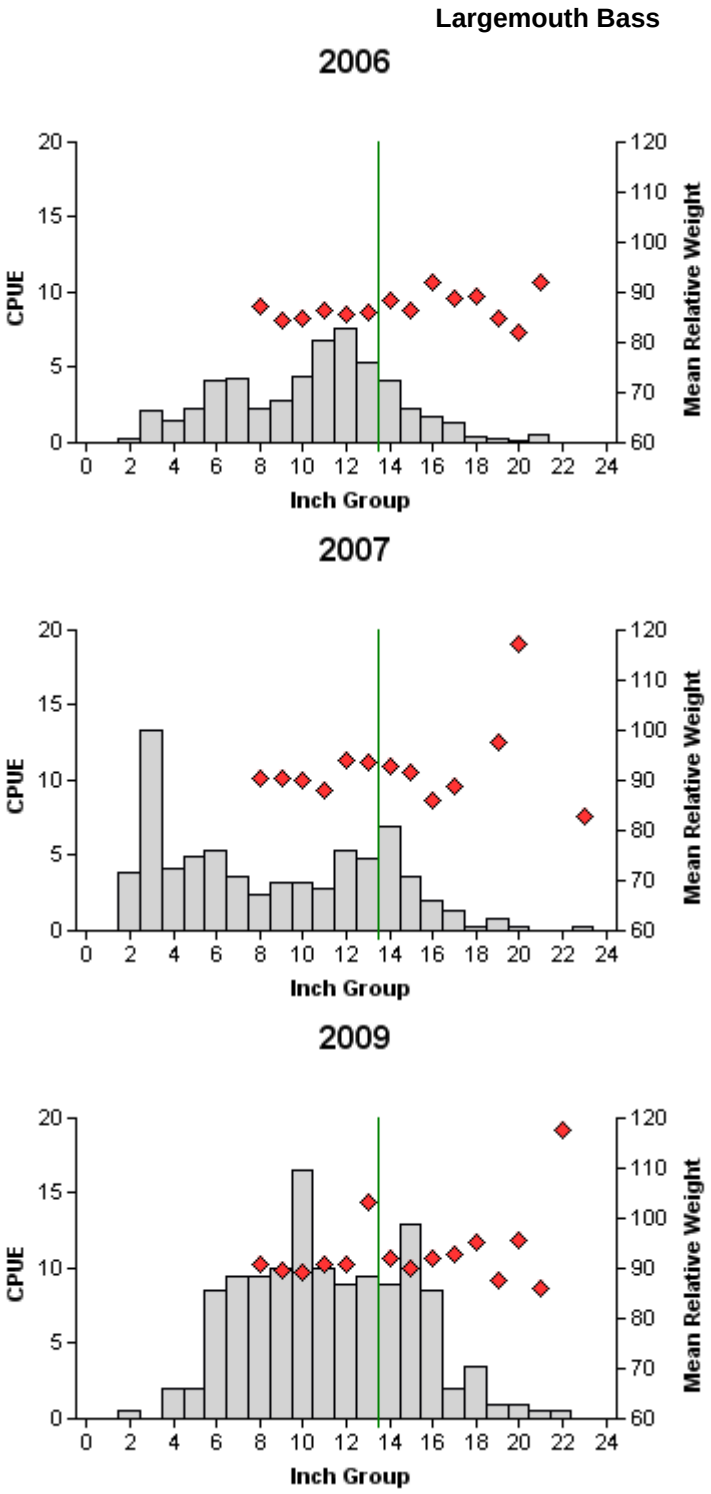


Figure 16. Number of largemouth bass caught per hour (CPUE, bars), mean relative weight (diamonds), and population indices (RSE and N are in parentheses) for fall bass-only electrofishing surveys, Amistad Reservoir, Texas, 2006, 2007, and 2009. RSE is used for CPUE values and SE is used for RSD and PSD values. The 2009 sample was conducted at random night time stations. The 2006 and 2007 samples were conducted during day and night, with random and biologist selected stations. Vertical line represents the minimum length limit.

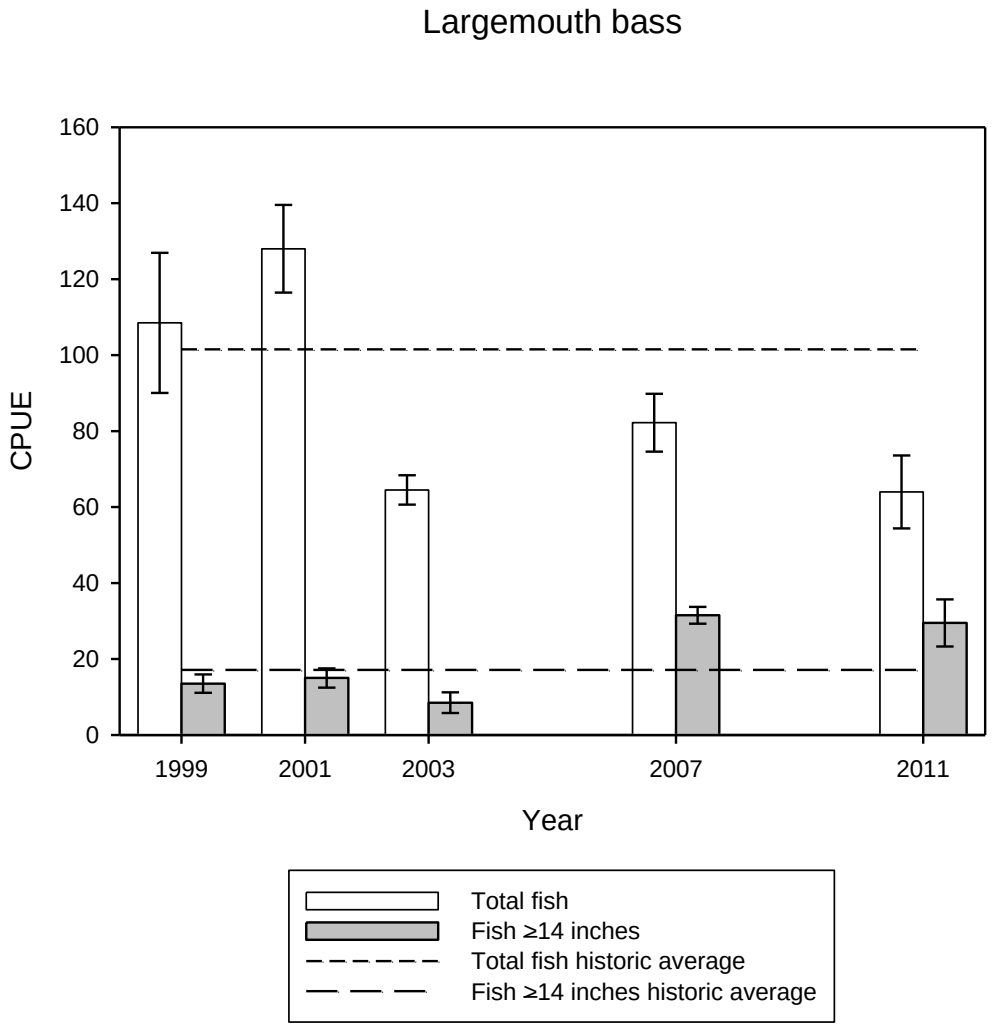


Figure 17. Total number and number ≥14 inches of largemouth bass caught per hour of electrofishing (CPUE) for nighttime fall surveys. Historic average CPUEs (represented by the dashed lines) were calculated using CPUEs determined prior to the current study period. The error bars represent ± one standard error.

Table 11. Results of genetic analysis of largemouth bass from Amistad Reservoir, Texas. Intergrade fish are those with both Florida largemouth bass (FLMB) and northern largemouth bass (NLMB) genes. Genetic analysis procedures changed from electrophoresis to micro-satellite DNA in 2005. Thus, % FLMB genotype estimates made during and after 2006 cannot be validly compared with previous estimates. Comparisons across years of % FLMB alleles values are valid.

		Number of fish by genotype				
Year	Sample size	FLMB	Intergrade	NLMB	% FLMB alleles	% FLMB genotype
1991	29	2	27	0	74.6	6.9
1993	35	4	29	2	49.3	11.4
1996	19	4	15	0	72.4	21.1
1999	32	10	21	1	68.0	31.3
2001	99	19	79	1	71.5	19.2
2003	50	23	27	0	80.5	46.0
2006	413	55	357	1	76.0	13.3
2009	30	7	23	0	82.0	23.0
2011	30	2	28	0	73.0	7.0

Table 12. Summary creel results for largemouth bass at Amistad Reservoir. The 2003 creel was conducted from 3/1/2002 to 2/28/2003 (12 months). The 2007 creel was conducted from 1/1/2007 to 12/31/2007 (12 months). The 2012 creel was conducted from 1/1/2012 to 6/30/2012 (6 months). Angling effort (hours) was estimated for anglers specifically targeting black basses. Harvest, catch, and release estimates (total number of fish) include largemouth bass caught by anglers targeting this species and by anglers targeting other species. HPUE and CPUE is the average number of fish harvested and caught, respectively, per one-hour angling effort by anglers targeting this species. Voluntary release rate is the percentage of legal-size fish (>14 inches) caught and released. Separate estimates are provided for tournament anglers (TO) and non-tournament anglers (NT) when possible, and TOT represents TO and NT combined.

	2003	2007			2012		
Creel statistic	TOT	NT	TO	TOT	NT	TO	TOT
Angling effort	265,263	373,018	228,729	601,747	188,607	92,543	281,150
Harvest	15,822	26,100	30,508	56,608	23,342	35,954	59,296
Catch	196,593	237,265	178,720	415,985	187,554	127,766	315,320
Release <14 inches	133,956	123.271	87,119	210,390	55,751	39,490	95,241
Release ≥14 inches	46,815	87,806	61,093	148,899	108,461	52,322	160,783
< 4 lbs				126,902			145,652
4-7 lbs				20,304			14,482
7-10 lbs				1,596			557
>10 lbs				145			93
Voluntary release rate[1]	74.7	77.1	66.7	72.5	82.3	59.3	73.1
CPUE	0.860	0.77	0.84	0.80	0.70	0.80	0.73
HPUE	0.051	0.07	0.16	0.10	0.08	0.29	0.17

[1]For tournament anglers, represents the percent of legal-size fish caught that were not weighed-in

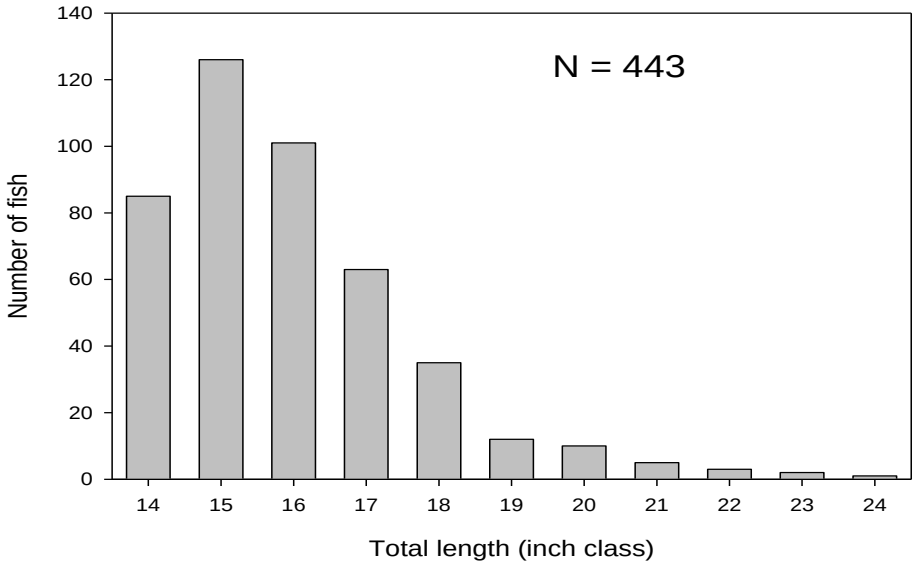
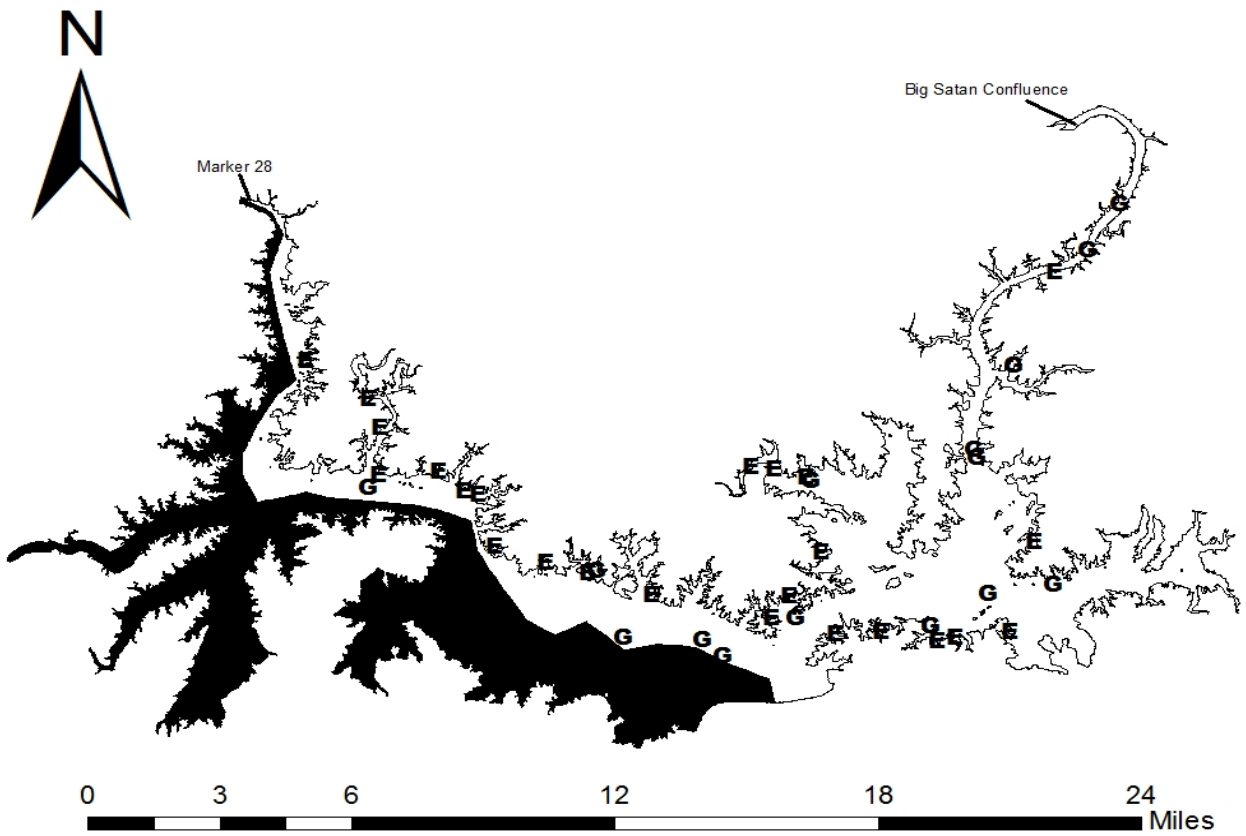


Figure 18. Length frequency distribution for largemouth bass harvested by anglers from January through June 2012.

Table 13. Proposed sampling schedule for Amistad Reservoir, Texas. Gill netting surveys are conducted in the winter/spring, and electrofishing, trap netting, and vegetation surveys are conducted in the fall. The creel survey will be conducted from 1/1/2015 to 6/30/2015. Standard survey denoted by S and additional survey denoted by A.

Survey Year	Electrofishing	Gill Net	Creel	Vegetation	Access	Report
Fall 2012-Spring 2013						
Fall 2013-Spring 2014	A	A				
Fall 2014-Spring 2015			A			
Fall 2015-Spring 2016	S	S		S	S	S

Appendix A



Location of gill net (G) and electrofishing (E) sampling sites, Amistad Reservoir, Texas, 2006-2007. The blacked-out portion of the reservoir represents Mexico jurisdiction. Marker 28 and Big Satan confluence are upstream boundaries of the reservoir.

Appendix B

Number (N) and catch rate (CPUE) of all target species collected from all gear types from Amistad Reservoir in 2011-2012, the most recent survey year.

Species	Gill Netting		Electrofishing	
	N	CPUE	N	CPUE
Spotted gar	6	0.43		
Longnose gar	4	0.29		
Gizzard shad			33	16.5
Common carp	9	0.64		
River carpsucker	6	0.43		
Smallmouth buffalo	1	0.07		
Channel catfish	14	1.0		
Flathead catfish	8	0.57		
White bass	66	4.71		
Striped bass	4	0.29		
Redbreast sunfish			206	103.0
Green sunfish			1	0.5
Warmouth			2	1.0
Bluegill			32	16.0
Redear sunfish			5	2.5
Smallmouth bass			2	1.0
Largemouth bass			128	64.0
White crappie	1	0.7		
Freshwater drum	29	2.07		

Appendix C

Predicted change in largemouth bass harvest given a daily bag limit reduction from 5 to 3 fish.

Angler type	Actual harvest under 5-fish bag limit	Predicted harvest under 3-fish bag limit	Percent reduction
Tournament	30,169	27,152	10.0
Non-tournament	23,014	19,815	13.9
Combined	53,183	46,967	11.7